What is claimed is:

1. A method for determining biological heat potential of biological reaction systems, particularly the ATAT system, which comprising the following steps:

using an acclimation apparatus to incubate an aerobic culture and transferring the culture into a reactor for the biological reaction test;

controlling, heating, and recording an ambient air surrounding the reactor at a first preset temperature;

controlling and supplying a pure oxygen to maintain the oxygen level at a preset value in a headspace of the reactor, and recording an on-line and real-time oxygen uptake data (O_u vs. t);

controlling and heating a content of the reactor at a second preset temperature, and recording an on-line and real-time heat compensation data (H_c vs. t);

using the oxygen uptake data and the heat compensation data to compute a specific biological heat potential (h_b) and a heat loss flux (J_o); and

using the calculated specific biological heat potential (h_b) and the heat loss flux (J_o) to compute a transient heat compensation ratio (r) and a minimal heat compensation ratio (r_{min}) during a reaction period.

2. A method for determining biological heat potential as recited in claim 1, wherein the on-line and real-time oxygen uptake data is obtained with an oxygen controller, which comprising means for controlling and providing the oxygen depleted in the reactor.

3. A method for determining biological heat potential as recited in claim 1, wherein the on-line and real-time heat compensation data is obtained with a heat compensation controller, which comprising means for controlling and heating the content of the reactor at the second preset temperature.

4. A method for determining biological heat potential as recited in claim 1, wherein the on-line and real-time oxygen uptake data (O_u vs. t) and the heat compensation data (H_c vs. t) are analyzed by a heat balance equation, considering a reaction term, a heat loss term, and a heat compensation term:

$$0 = \underset{reaction}{h_b \frac{dO_u}{dt}} - \underset{loss}{J_0} + \underset{compensation}{\frac{dH_c}{dt}} \qquad (1)$$

where h_b being the specific biological heat potential in the unit of kcal/g BODr, O_u being the accumulated oxygen uptake data in the unit of g, J_o being the heat loss flux in the unit of kcal/min, and H_c being the accumulated compensated heat in the unit of kcal; and

integrating equation (1) with the initial conditions of $t = 0$, $O_u = 0$, and $H_c = 0$ to obtain

$$H_c = J_o t - h_b O_u \qquad (2).$$

5. A method for determining biological heat potential as recited in claim 4, wherein the specific biological heat potential (h_b) and the heat loss flux (J_o) are used to calculate a heat compensation ratio (r):

$$r = H_c/J_o t \qquad (3).$$

6. A device for determining biological heat potential comprising:

an acclimation apparatus to incubate an aerobic seed culture;

a reactor receiving the seed culture from the acclimation apparatus to carry out a biological reaction;

an external temperature controller to control and heat an ambient air surrounding the reactor at a first preset temperature;

an oxygen controller to provide and record an oxygen depleted within the reactor with an on-line and real-time output of oxygen uptake data (O_u vs. t);

an internal heat controller to control and heat the reactor at a second preset

temperature with an on-line and real-time output of heat compensation data (H_c vs. t);

a specific biological heat potential evaluator using the on-line and real-time data of oxygen uptake and heat compensation to determine a specific biological heat potential (h_b) and a heat loss flux (J_o);

a heat compensation ratio evaluator using the specific biological heat potential (h_b) and the heat loss flux (J_o) to determine a heat compensation ratio (r) and a minimal heat compensation ratio (r_{min}) during a reaction period.

7. A device for determining biological heat potential as recited in claim 6, wherein the acclimation apparatus comprises an air pump for aeration via a fine-bubble diffuser on a bottom portion the reactor, a temperature probe connected to a heater and a proportional integrated derivative (PID) temperature controller to maintain the reactor at a constant temperature, a heavy-duty magnate on the bottom portion of the reactor driven by a magnetic stirrer for homogenous mixing, and two glass bottles for storing a substrate solution and a nutrient solution being fed simultaneously by a peristaltic pump at a preset flow rate to maintain at a preset sludge retention time (SRT) and substrate concentration (S) for the reactor.

8. A device for determining biological heat potential as recited in claim 7, wherein a reflux condenser is connected to a top portion of the acclimation reactor to prevent a loss of liquid solution via evaporation.

9. A device for determining biological heat potential as recited in claim 6, wherein comprising means for evaluating the spontaneity of an autothermal thermophilic aerobic treatment system.

10. A device for determining biological heat potential comprising a reactor, an

oxygen controller, an internal heat controller, an external temperature controller, a mixing controller, and a signal and data controller with the following characteristics:

comprising means for programmable on-line and real-time monitor and control of a transient oxygen uptake data and a heat compensation data, and using a heat balance analysis to process a specific biological heat potential algorithm for biological reaction thermodynamics and autothermal thermophilic aerobic treatment feasibility study.

11. A device for determining biological heat potential as recited in claim 10, wherein the oxygen controller, according to the estimate by an oxygen probe, uses a computer program with an on/off control mechanism connecting to an oxygen source to provide a preset flowrate of oxygen per on-time, which can be recorded and calculated to be the oxygen uptake data, and a carbon dioxide formed during oxidation is absorbed by a strong basic solution within a CO_2 stripper.

12. A device for determining biological heat potential as recited in claim 10, wherein the heat compensation temperature controller, according to the estimate of a temperature probe, uses a computer program with an on/off control mechanism connecting a heater with a fixed power to maintain the temperature of the reactor at a preset temperature, which can be recorded and calculated to be the heat compensation data.

13. A device for determining biological heat potential as recited in claim 10, wherein the mixing controller comprises a magnate on a bottom portion of the reactor driven by a magnetic stirrer for high-strength mixing.

14. A device for determining biological heat potential as recited in claim 11,

wherein the signal and data controller comprises a signal and data processor and a signal interface assembly and an on-line and real-time computer program, which contains means for monitoring, controlling, and showing dynamic plots of a mixing speed of the magnetic stirrer, an internal and external temperatures of the reactor, the oxygen uptake data, and the heat compensation data.

15. A device for determining biological heat potential as recited in claim 10, wherein the external temperature controller comprising an external temperature probe on an external portion of the reactor and an external heater can be incorporated to a computer program for maintaining the external portion of the reactor at a high temperature for reducing the heat loss.